Accelerator Division

Andrew Hutton
Associate Director for Accelerators

June 30, 2008

Science and Technology Review
Jefferson Lab
June 30-July 2, 2008

Outline

- Organization, staff and budget
- 12 GeV support
- 6 GeV program
- Long-term vision, R&D and partnerships
- Education

Staff Changes

New Director of Operations

- When I became Associate Director, Accelerators, the position of Director of Operations became vacant
- The position was advertised nationally and internationally
  - Search Committee had Physics Division and User members in addition to Accelerator and Engineering
- Nine candidates were given a preliminary interview
  - 5 internal, 4 external
    - Really excellent candidates
  - We retained 5 candidates for a second round of in-depth interviews, seminar
- Arne Freyberger was selected

Arne Freyberger

- Arne received his bachelor's degree in physics and math from Rutgers and earned his master's and Ph.D. in physics from Carnegie Mellon
- As a postdoctoral fellow, he worked on the CLEO experiment at Cornell
- He came to Jefferson Lab in 1994 and worked on all aspects of the Hall B commissioning
- In 2002, he moved to the Accelerator Division, working with the beam diagnostic equipment

Arne brings his experience as a User and an accelerator physicist to the position of Director of Operations

Center for Advanced Studies of Accelerators

Lia Merminga, Director of the Center for Advanced Studies of Accelerators (CASA) has been offered the position of Director of Accelerators at TRIUMF

- **We are proud that Lia was offered this important position**

Geoff Krafft is Acting Director of CASA

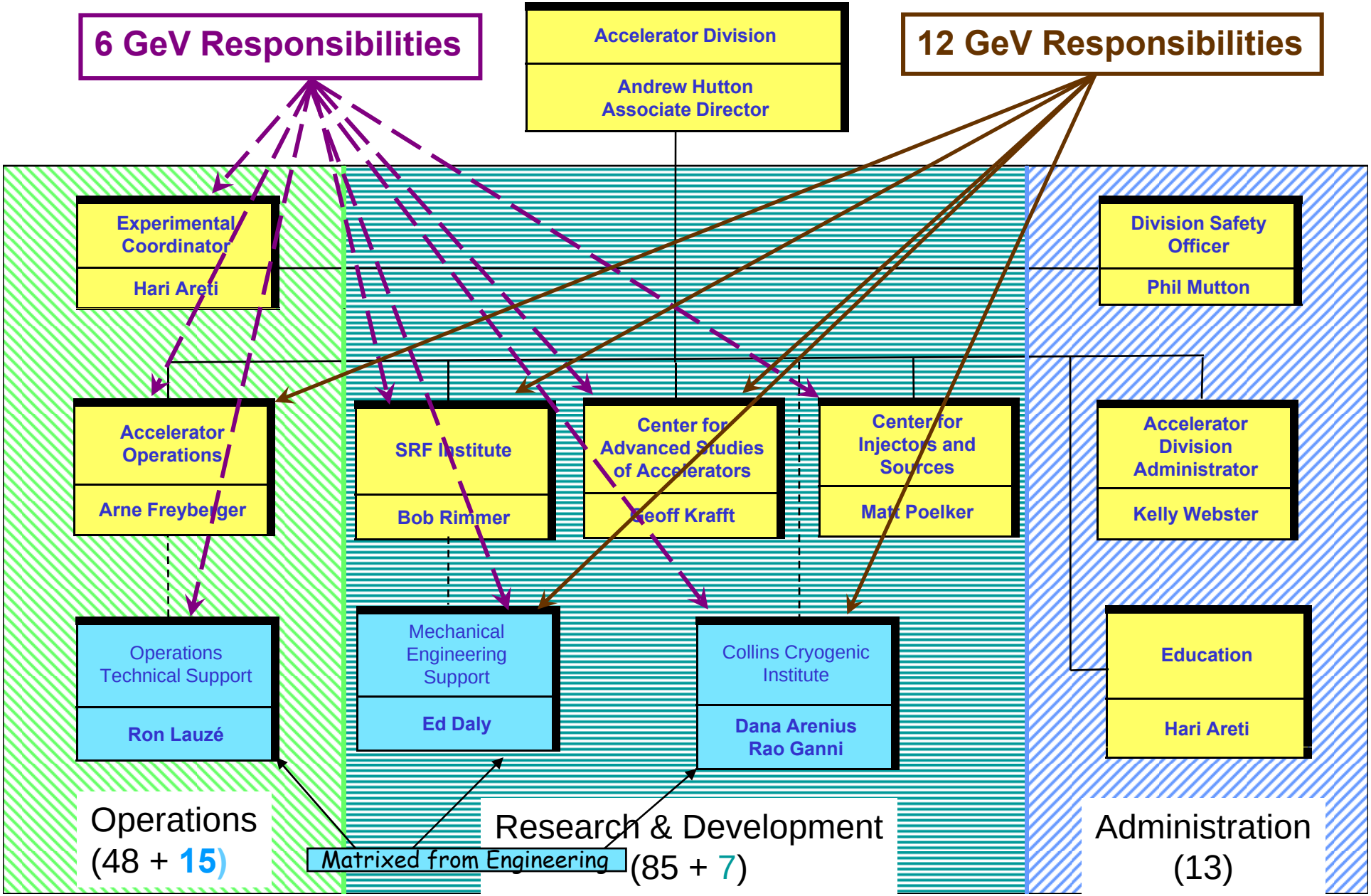
PhD in Accelerator Physics from Berkeley, helped design and commission CEBAF, has published and lectured widely in Accelerator Physics

Head of Education – Hari Areti

- Hari Areti has been in charge of the Accelerator Division student program for the last 6 years
  - Hari continues in this role
- In addition, Hari has recently been appointed Head of JLab Graduate Student Affairs, overseeing:
  - 195 PhD students
    - 66 stationed at JLab

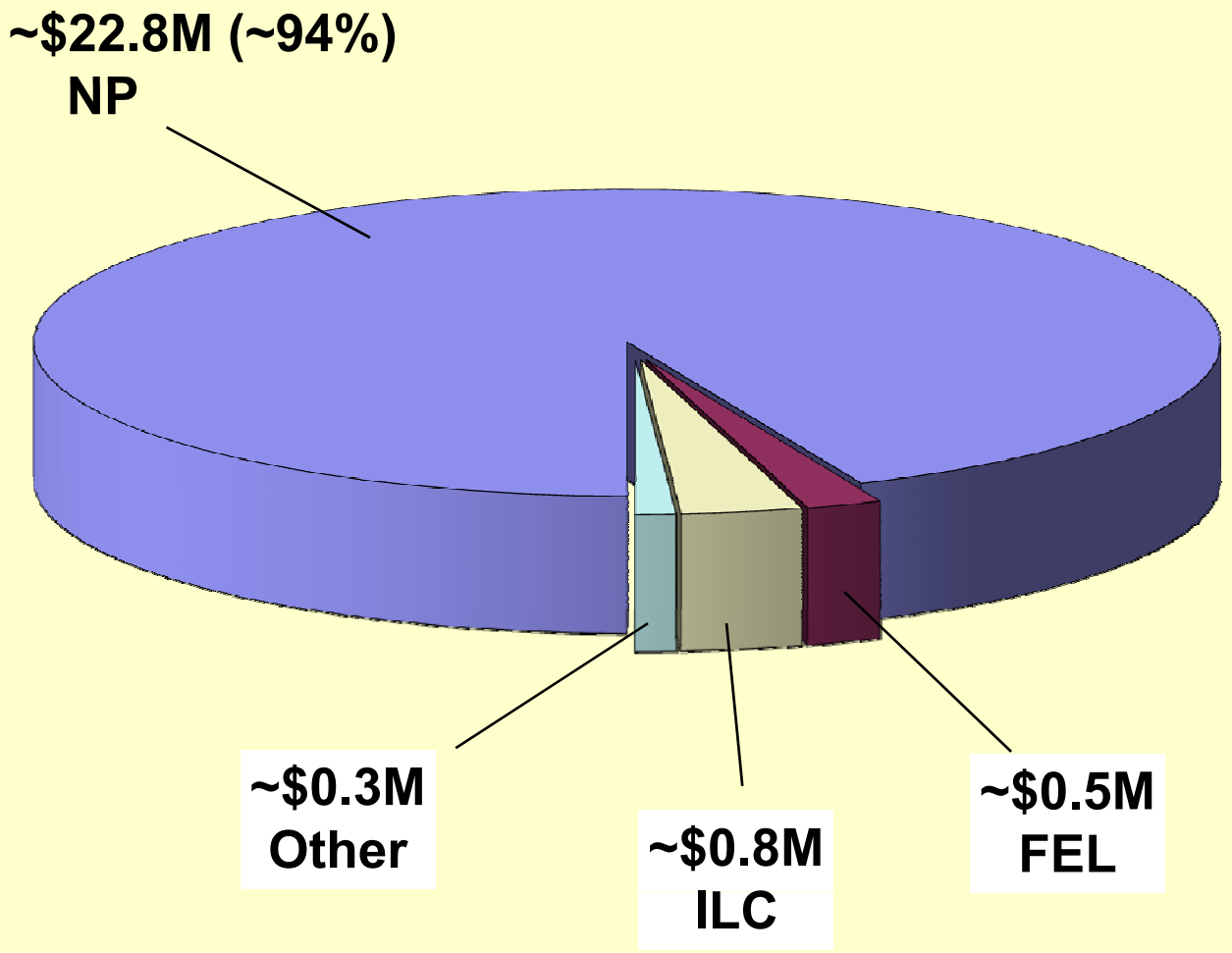
Organization and Budget

Accelerator Division Organization



Current Accelerator Division Budget $FY08

Budgets include overhead



Accelerator Budget

		Acc. Ops $K	Acc R&D $K	AIP $K	FTEs FY08
Research	KB0101021	62			0.2
Accelerator Operations	KB0102011	21,519	1,000		132.2
Experiment Support	KB0102012	52			0.3
AIP	KB0102011 (AIP)				
GPP	KB0102011 (GPP)				
Capital Equipment	KB0102012 (EQU)	152			.4
Total NP Funding		21,785	1,000	0	133.1

More details in supplemental slides

Priorities

- **The Accelerator Division has four main responsibilities:**
  1. **Provide support to the 12 GeV project**
  2. **Operate CEBAF to deliver the 6 GeV Nuclear Physics program**
  3. **Position JLab for a future beyond 12 GeV**

     Continue outside collaborations which support the long-term mission of the lab
  4. **Education**

List is in priority order

12 GeV and 6 GeV Program for FY07/FY08

Provide support to the 12 GeV project

- Most Groups in the Accelerator Division provide support for the 12 GeV Upgrade Project
- Support is led by Accelerator staff matrixed to the 12 GeV Project:
  - Integration Engineer
    - Steve Suhring
  - Two 12 GeV Associate Project Managers
    - John Hogan – SRF
    - Mike Spata – Extraction, controls and instrumentation, commissioning
  - Accelerator Design
    - CASA (Mike Tiefenback, Jay Benesch, Alex Bogacz, Yu-Chiu Chao, Jean Delayen, Yves Roblin, Chris Tennant, Yuhong Zhang)
  - Software
    - Matt Bickley, Brian Bevins

12 GeV Responsibilities

- The Accelerator Division has primary responsibility for:
  - Developing and producing ten 100 MV cryomodules
  - Designing the accelerator beam optics and defining the component specifications
  - Designing and specifying the beam instrumentation, safety and controls systems
  - Defining and delivering the beam separation systems
  - Planning and executing accelerator beam commissioning
- Accelerator Division also provides support in other areas
  - Many of the improvements for the “6 GeV hardening” program will also benefit the 12 GeV Upgrade

12 GeV Deliverables in FY07/FY08

- **Deliverables for CD-2**
  - ✓ Finalize and document the beam optics and component layout
  - ✓ Complete quarter-cryomodule testing to demonstrate achievement of performance required for the Upgrade cryomodules
  - ✓ Multiple other smaller R&D deliverables
  - ✓ Participated in two successful major Reviews
    - "Lehman" Review in June 2007
    - External Independent Review (EIR)
- **Deliverables for CD-3**
  - ✓ Finalize and document component specifications
  - ✓ Prepare early procurement packages for cryomodules
  - ✓ Contribute to CD-3 documentation packages
- **Prepare for "Lehman" Review in July 2008**

Deliver the 6 GeV Nuclear Physics program

- JLab Operations has a world-leading program
- Systems and protocols in place to structure operations
  - Arne Freyberger has done an excellent job taking over and leading the Operations team
  - The Operations Group Leaders have helped maintain continuity during the leadership transition
- Operations statistics confirm the excellent performance
  - Successfully completed 15 experiments in FY08
  - Exceeded availability goals
- Most importantly, the team led by Arne successfully solved the daily problems of operations to make the Users happy (feedback from experiment exit interviews)

More from Arne Freyberger

6 GeV Deliverables in FY07/08

- ✓ During the 2007 Summer Downtime
  - Commissioned Renascence and two C-50 cryomodules
  - Carried out maintenance safely and efficiently
    - We have an extensive list of maintenance tasks
      - Includes some "6 GeV hardening" projects
- ✓ Operated at 5.1 GeV in June 2007
  - ✓ Experimental program only needed 4.5 GeV for Fall 2007
- ✓ During the 2008 January/February Downtime
  - Installed and commissioned 2 more C-50 cryomodules
- ✓ March – June operated at 5.75 GeV, ~600kW beam power
- During 2008 Summer Downtime
  - Will install 2 more C-50 cryomodules
    - Refurbishment is on track
- Operations for Physics will resume October 10 at 5.9 GeV

10 Year Energy Strategy

Installation	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16
Renascence	1	-	-	-	-	-	-	-	-	-
C50	3	3	3	1	-	-	1	2	2	2
C100 build	-	-	-	3	4	3	-	-	-	-
C100 install	-	-	-	-	-	-	10	-	-	-
New/Refurbished Cryomodule Capability										
Renascence	60 * MeV	-	-	-	-	-	-	-	-	-
C50	3x50 MeV	3x50 MeV	3x50 MeV	50 MeV	-	-	50 MeV	2x50 MeV	2x50 MeV	2x50 MeV
C100							10x100 MeV	-	-	-
Hall A, B, C Max Energy	5.1 ° GeV	5.9 ° GeV	6 GeV	6 GeV	6 GeV	6 GeV	11 GeV	11 GeV	11 GeV	11 GeV
Overhead	-	-	0.5 GeV	0.6 GeV	0.6 GeV	0.6 GeV	1.1 GeV	1.2 GeV	1.3 GeV	1.4 GeV
Hall D Max Energy	-	-	-	-	-	-	12 GeV	12 GeV	12 GeV	12 GeV
Overhead							1.1 GeV	1.2 GeV	1.3 GeV	1.4 GeV

Done

On Track

* RF power limited, cryomodule capability >80 MV

° Energy available at the end of the fiscal year

Beam Instabilities - BBU

- We started to observe beam instabilities after the Renascence cryomodule was installed in CEBAF
  - Careful detective work pointed to Beam Break-Up (BBU)
  - Identified with two cavities
  - Machine tuning could excite one of two modes
- Construction records showed an abnormal (but apparently benign) change in procedure was used for these cavities
  - They had to be physically squeezed more than usual to bring the fundamental mode into the tuning range
- Simulations performed at SLAC showed that squeezing by a large amount reduces the HOM coupling for two modes
  - Mode frequencies match the two measured instabilities
- Detailed measurements match the BBU model

BBU (Continued)

- We have found a way of tuning the machine optics to mitigate the problem

  Talk by Arne Freyberger

- The SRF Group has changed QA procedures to avoid the problem in the future

  Talk by Bob Rimmer

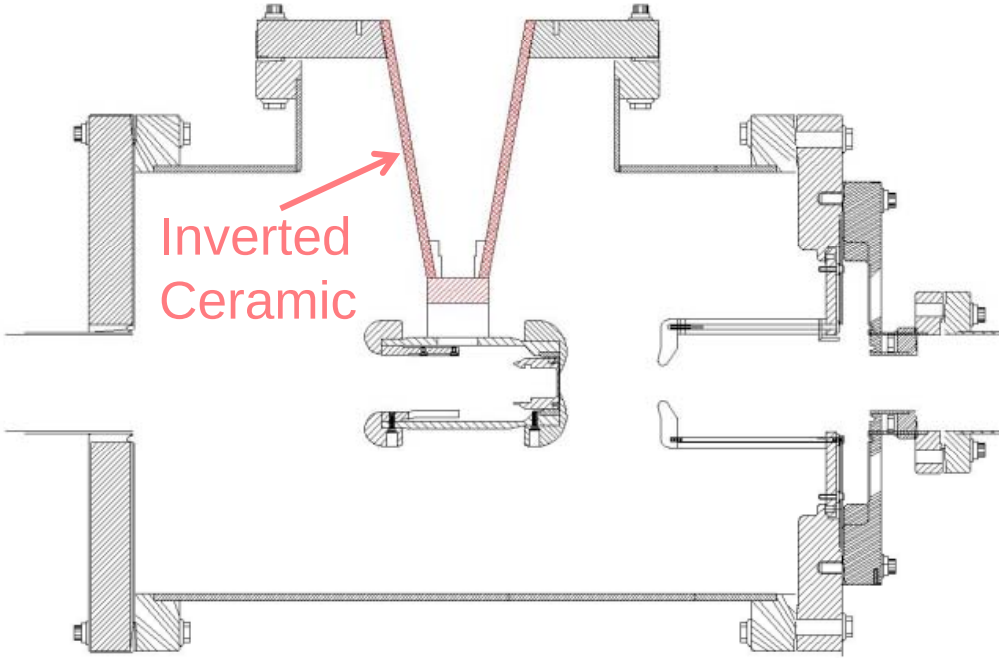
- CASA and the RF Engineering Group provided a lot of support to help understand the problem
  - This work will be included in the talk by Arne Freyberger

Prepare 6 GeV Deliverables for FY08 and Beyond

- Some experiments have new, harder beam specifications
  - Q_{weak} requires the highest beam current ever delivered (180μA) with excellent parity specifications
  - Load-Lock Gun since July 2007
    - Rapid photocathode swaps
  - Develop a 200kV photogun
    - Improved transmission and lifetime

Goal is to develop solutions early

More from Joe Grames



6 GeV Hardening

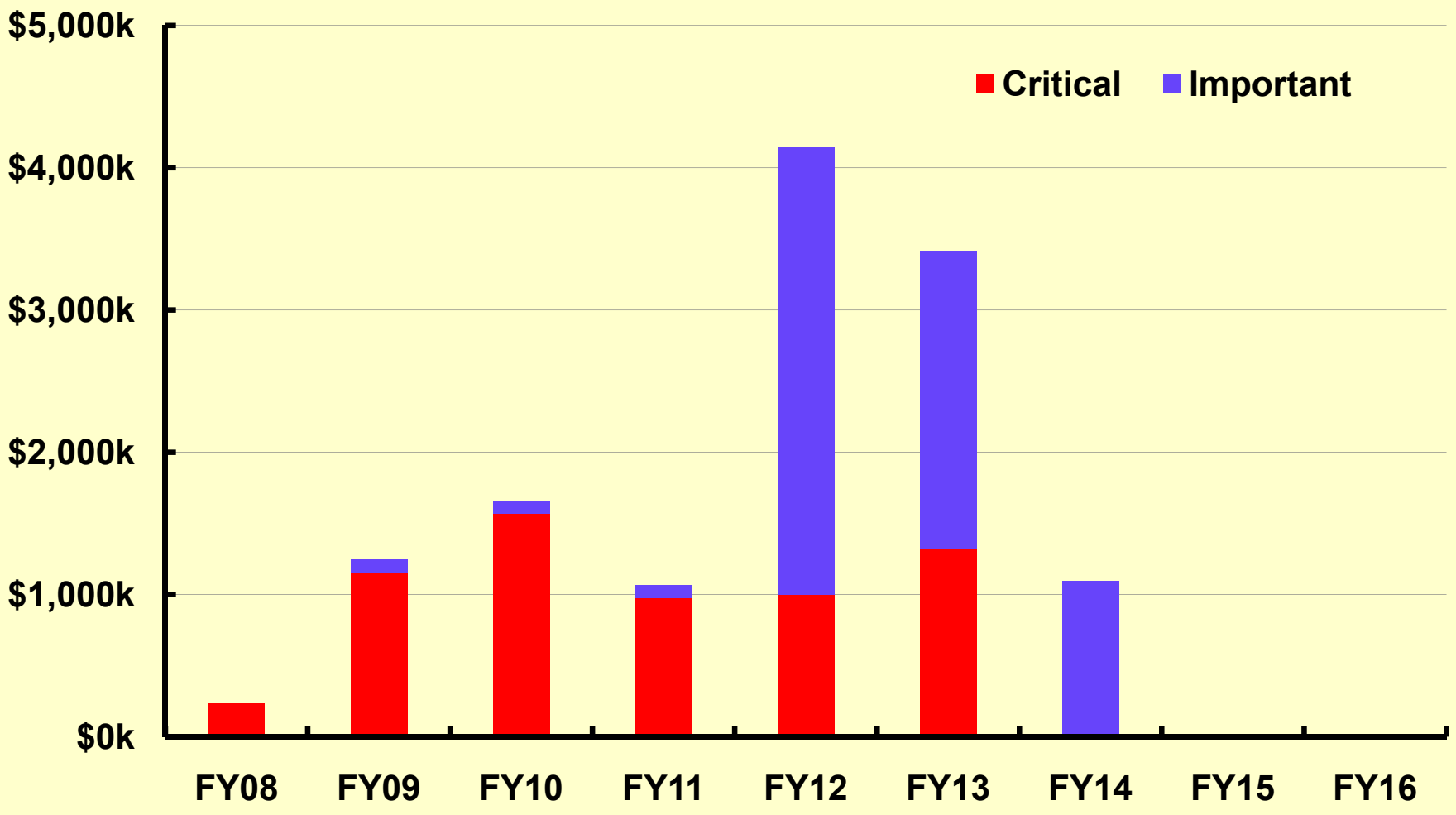
- The 12 GeV User program requires:
  - Successful completion of the 12 GeV Project
  - Aging CEBAF accelerator must be able to operate with high reliability – "6 GeV hardening"
- 6 GeV hardening program involves multi-year projects that will have to be re-prioritized annually depending on the budget and lab resources available
- Accelerator Division is directing this program
  - Relies on resources from other Divisions:
    - Engineering
    - Facilities

6 GeV Hardening Projects

- Refurbish cryomodules (the C50 program)
  - Joe Preble, Accelerator — On track
- Purchase new RF sources (klystrons), rebuild old klystrons when economically viable, upgrade the HPAs for higher power — On hold for lack of funds
  - Rick Nelson, Engineering; Jay Benesch, Accelerator
- Replace older equipment to improve maintainability or reliability, creating underpinnings for 12 GeV Upgrade
  - Will Oren, Engineering — Slowed down for lack of funds
- Aggressive preventive maintenance on older electronic equipment (e.g. replacement of corroded connectors)
  - Ron Lauzé, Engineering; Steve Suhring, Accelerator

6 GeV Hardening Budget Needs

Total budget and annual distribution are a concern



Long-Term Vision

ELectron Ion Collider (ELIC)

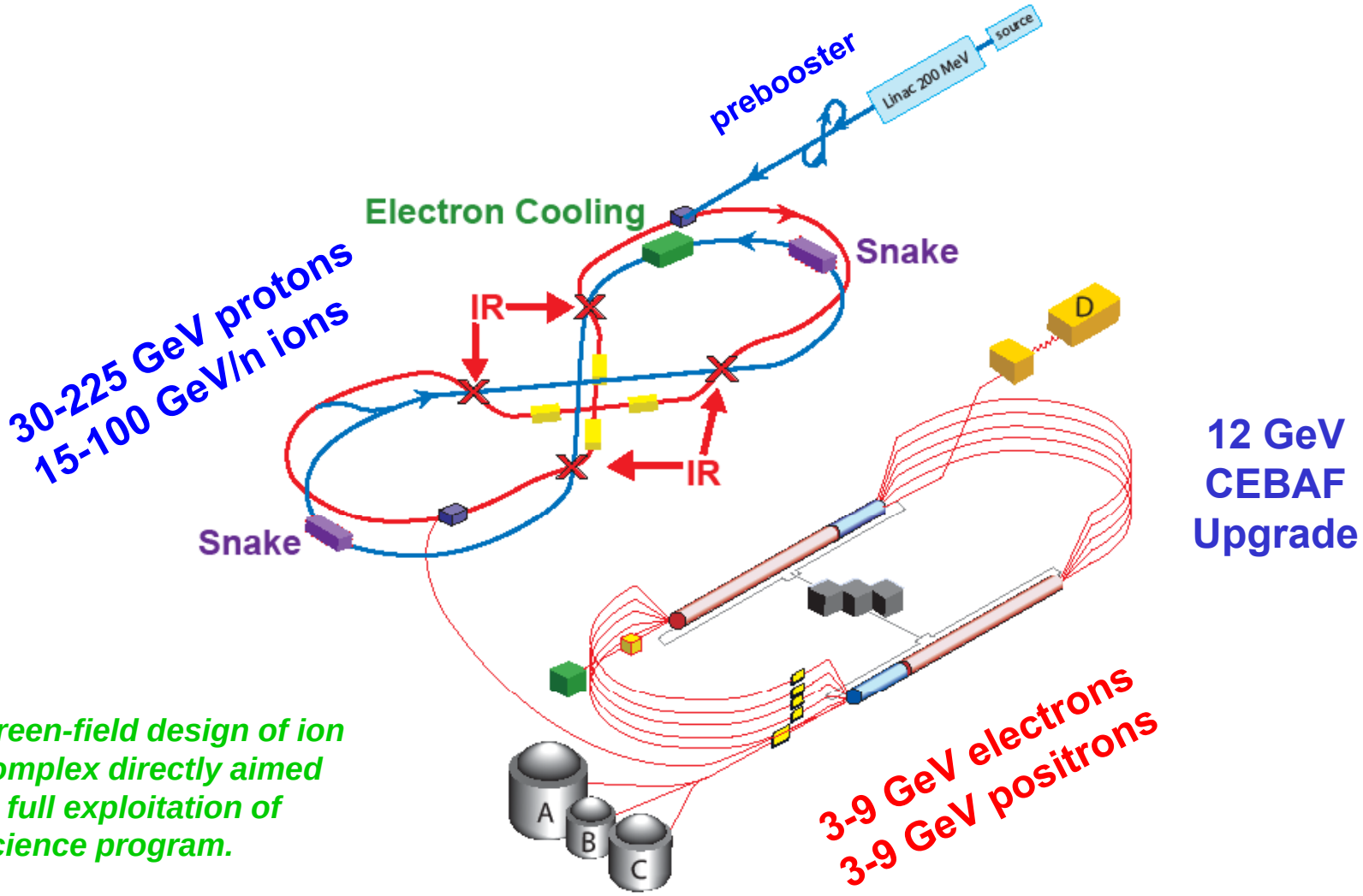
- The top choice for a future facility at JLab is ELIC
  - Slava Derbenev, and others from CASA and Physics, have been studying this option
  - The JLab proposal is optimized for extremely high luminosity with high polarization
- Organized a workshop on Electron Ion Colliders at Hampton University
  - Presentations on ELIC, eRHIC, LHeC
- We continue to seek funding for generic EIC R&D
  - R&D plan has been proposed
  - R&D would include accelerator physicists, scientists and engineers in CASA, SRF, cryogenics and injectors

Ring–Ring Electron–Ion Collider (9 on 225 GeV)

- Figure 8 layout ensures polarization of ions and electrons
  - Four Interaction Regions (IRs)
- Extremely high peak luminosity per IR: 2.6×10^{34} cm^{-2} s^{-1}
  - Enabled by short ion bunches (σ_z = 5mm), low β* (5mm)
  - Luminosity reduced during Hampton workshop due to User request for longer inter-bunch spacing
    - Repetition rate (1.5 GHz ⇨ 0.5 GHz)
- 'Crab Crossing' required to improve luminosity and to mitigate parasitic beam-beam interaction
  - Superconducting crab cavities need development

More from Geoff Krafft

ELIC Conceptual Design



Green-field design of ion complex directly aimed at full exploitation of science program.

Other Options for an On-Site Facility

- Other options for an on-site facility are being evaluated
  - Positron option for CEBAF
  - FEL User Facility
  - SRF linac based 4th generation synchrotron light source
- Other options may be (re)studied
  - 25 GeV CEBAF
- All of these options build on our core competencies

Current R&D is applicable to any of these options

4th Generation Light Source R&D

- BES is expected to invite bids for accelerator R&D to enable a 4th generation light source
- JLab existing R&D portfolio puts us in a strong position
  - Accelerator will work closely with the FEL Division
- We will bid for all SRF or cryogenic R&D
  - We aim to be major players in these areas
- We will also bid for injector R&D
  - We are arguably world leaders in this area
  - We may not be successful because R&D needs to be apportioned and others would like to get into this field
- We will also bid for accelerator physics studies
  - We are currently world leaders in beam dynamics of injectors and superconducting linacs

R&D Portfolio

R&D Strengths

- Accelerator Division contains the core competencies in accelerator science and technology
  - SRF (SRF Institute) led by Bob Rimmer
  - Cryogenics R&D led by Dana Arenius and Rao Ganni
    - Matrixed from Engineering
  - Accelerator Physics (CASA) led by Geoff Krafft
  - Center for Injectors and Sources led by Matt Poelker
- The FEL Division is also tightly coupled
- These core competencies define JLab accelerator science

High current, CW, superconducting, multi-pass linacs this explicitly includes energy recovery linacs

Accelerator Division R&D Goals

- Our goal is World Leadership in all our core competencies
  - CW SRF
    - Expect to drop to World Class in pulsed SRF as ILC investment goes to other labs (Fermilab . . . .)
  - High-efficiency cryogenics
  - Accelerator physics (special focus on ELIC and ERLs)
  - Electron injectors (high current, CW, polarized and unpolarized)

- Goals have been established for each R&D area which support the Accelerator Division Goals
  - Aiming for total alignment of the different R&D areas

SRF Institute

- The SRF Institute has fabricated and/or processed a wider variety of multi-cell SRF cavities than anyone else
- 608 multi-cell cavities fabricated / processed (was 549)
  - 25 different cavity types, including:
    - 9 different frequencies
    - 6 different beta values
    - Both CW and pulsed
- In addition a large number of single cell test cavities have been fabricated and/or processed
  - So many, we do not even have an exact count!

Project	# of Cavities built @ Jlab	# of Cavities processed / tested	Frequency (MHz)	Beta	# of Cells	Duty Factor
CEBAF (OC cell shape)	20	358	1497	1	5	CW
CEBAF (OC) - C50 rework		28+ **46**	1497	1	5	CW
CEBAF Upgrade Style (OC)	8	8	1497	1	7	CW
CEBAF Upgrade Style (LL)	5	5	1497	1	7	CW
CEBAF Upgrade Style (HG)	9	9	1497	1	7	CW
C100 - (LL)	2	2	1497	1	7	CW
FEL IR DEMO (OC)	10	10	1497	1	5	CW
FEL 10 kW Upgrade (OC)	8	8	1497	1	7	CW
FEL HCCM (HC)	3	1	1497	1	5	CW
FEL HCCM (HC)	1		750	1	5	CW
AES HC Inj		**3**	750	1	1	CW
AES HC Inj		**1**	1500	1	1	CW
APT	2	2	700	0.64	3	CW
APT		3	700	0.64	5	CW
SNS	4	37	805	0.61	6	Pulsed
SNS	1	49+ **3**	805	0.81	6	Pulsed
RIA	2	2	805	0.47	6	Pulsed
INFN Legnaro - seamless		1	1500	1	5	CW
INFN Milan - TRASCO		1	703	0.5	5	CW
DESY - seamless		3	1300	1	2	CW
KEK	1	1	1300	1	10	Pulsed
ILC-like - superstructure	1	1	1497	1	10	Pulsed
BNL		1	704	1	5	CW
FLASH - FNAL/DESY	5		3900	1	9	Pulsed
ILC - (TESLA)		6 + **3**	1300	1	9	Pulsed
ILC - (LL)	1	1	1300	1	7	Pulsed
ILC - (Japan LL)		**1**	1300	1	9	Pulsed
ILC - (TESLA)	4	**2**	1300	1	9	Pulsed

59 additional cavities since 2007 S&T Review

Seven SRF Goals

1. Eradicate field emission up to 35 MV/m
2. Increase the maximum gradient to > 50 MV/m
3. Reduce spread in quench gradient to ±5% of mean
4. Develop cavities for high currents (~1Amp)
5. Increase Q at 25 MV/m
6. Reduce cost per MV
7. Develop a solution for operation at 4.5K

More from Bob Rimmer

Collins Cryogenics Institute

- R+D centered on both large and small helium refrigeration system operational efficiencies and system cost
- Advanced degree thesis work integrated into the R&D activities
- FY2008 focus areas included improvements to the warm helium compression systems and helium purification
- Substantial funding from external sources for common development interests
  - JLab projects have benefited
    - E.g. the JLab 12 GeV helium refrigeration system

Three Cryogenic Goals

- Goal 1: Increase Carnot Efficiency at 2K for ~5kW systems
  - Increase system Carnot efficiency from 18% to 28% at 2K for a large scale plant (~4.6 kW)
- Goal 2: Increase Carnot Efficiency at 2K for ~1kW systems
  - Design a higher efficiency (3300 ⇨ 2000 W/W @ 2K) upgrade or replacement for the CTF as test-bed and to meet the future needs of the Test Lab and TEDF
    - Seek funding opportunities for building CTF upgrade or replacement
- Goal 3: Develop a Stand-Alone 4.5K Plant
  - Develop parameters for a stand-alone high efficiency 4.5K cryogenic plant for a ~10 MeV CW SRF accelerator

More from Dana Arenius

Center for Advanced Studies of Accelerators

- 14 professional staff, 8 graduate students
- Specializing in:
  - Multi-pass linacs
  - Energy recovery linacs
  - Superconducting cavity interactions with electron beam
  - Transport optics
  - Electron Ion Collider design
  - Simulations
- Same group provides optics support to 12 GeV Upgrade, will commission the 12 GeV machine and actively supports the 6 GeV Physics program

Five CASA Goals

1. Advance the concept, design and documentation of Electron Ion Collider
2. Evaluate all current limiting phenomena in Energy Recovery Linacs (ERLs) and develop mitigation techniques
3. Investigate and deploy beam-based measurement procedures and instrumentation for Recirculated Linear Accelerators (RLAs) and ERLs
4. Investigate, in collaboration with the FEL Dept, concepts for a Fourth Generation Light Source (4GLS)
5. Explore feasibility and limiting factors of large-acceptance Recirculating Linear Accelerators (RLAs) based on Superconducting RF

More from Geoff Krafft

Center for Injectors and Sources

- JLab leads the world in delivery of CW beams
  - At CEBAF, world record polarized beams
    - > 85% polarization measured by the Users at the Hall
    - 16 Coulombs delivered in one 24 hr period
      - An average of 185 μA for 24 hours
    - Load-lock gun has operated at 1 mA in test stand
      - Nearest competitors – Bates 120 μA, Mainz 50 μA
    - Test Cave research to support new initiatives like EIC and ILC
  - At the FEL, world record unpolarized beams
    - > 9 mA achieved daily for months at a time
      - Nearest competitor - Cornell ERL test stand 5 mA

Six Injector and Source Goals

1. Improve performance of CEBAF photoinjector
2. High Average Current
3. High Bunch Charge
4. High Peak Current
5. Positrons at CEBAF
6. Parity violation experiments

More from Joe Grames

External Partnerships

Cross-Project R&D Funding

- We seek R&D funding from any project that needs our core competencies
  - We can be a cost-effective R&D partner because of our present experience
  - But carrying out the R&D will reinforce our leadership in our core competencies
    - Will make us even more cost-effective in the future
- Examples
  - Digital RF controls funded jointly by 12 GeV and RIA
  - High efficiency cryogenics funded by NASA (12 GeV)
  - High current cavities funded by ONR (electron cooling)
  - High voltage guns funded by ILC (6 GeV)
  - Crab cavities funded by APS (ELIC)

Partnerships Being Negotiated

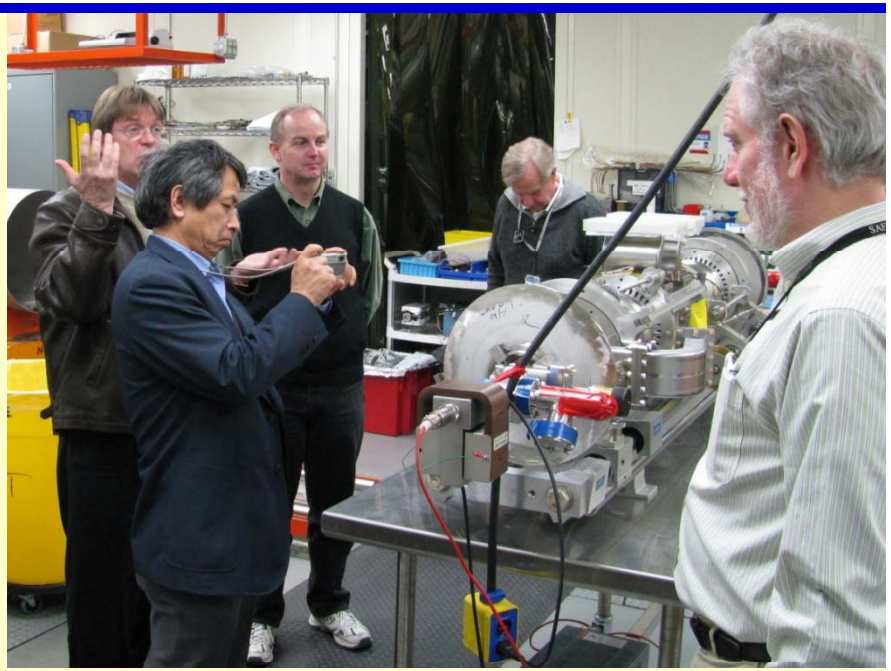
- In all cases, JLab participation is based on SRF technology and cryogenics, backed by accelerator theory, diagnostics and, in two cases, injectors
  1. ILC
  2. Japan-USA Cooperation Agreement
  3. FRIB at either ANL-ATLAS or MSU
     - I cannot discuss details because FRIB is currently the subject of a FOA and some of the DOE officials who will make the decision are present (I can talk off-line with members of the Review Committee)
  4. PUP (Power Upgrade Project) at SNS
  5. Project X at Fermilab
  6. APS at ANL

Role of JLab in ILC

- We are actively supporting ILC
  - Leading role in SRF R&D program
  - US lead in electron gun R&D
- ILC funding for FY08 was originally $ 1.40M
  - Reduced to $ 0.8 M due to budget cuts
  - Caused major budget problems for Accelerator Division
    - Planned on external funding to maintain our staff

ILC Interactions

- Hosted ILC Project Managers Akira Yamamoto & Marc Ross
- Formal proposal for FY09 ILC funds to Mike Harrison, DOE
  - Provisionally accepted
  - Value – $2.1 M



- Funds go to SRF Institute for single cell and 9-cell processing, large grain niobium cavities and basic R&D ($1.7 M)
- Funds also go to Center for Injectors and Sources for high voltage gun R&D ($370 k)
- As an NP-funded laboratory, obtaining ILC funds is not easy but we are persevering!

Japan-USA Cooperation Funds

- We received $74k this year to work on the KEK "ICHIRO" 9-cell cavity
  - Processing, high pressure rinsing, electro-polishing
- Results were outstanding 36 MV/m
  - Collaboration with KEK worked very well
- We expect $80k - $200k next Japanese fiscal year (April–March)

FRIB

- **A Funding Opportunity Announcement (FOA) was issued for the Facility for Rare Isotope Beams (FRIB) on May 20, 2008**
  - **FRIB is a facility designed to study Nuclear Structure Physics**

> This Funding Opportunity Announcement (FOA) requests proposals for the conceptual design and establishment of a Facility for Rare Isotope Beams (FRIB).
>
> The proposed FRIB must be capable of mounting a world-class scientific research program at the start of operation, and can be designed, built and commissioned for less than or equal to $550,000,000 in escalated "Then Year" dollars.
>
> The specifications in the FOA are formed from the recent reports of the Rare Isotope Beam Task Force of the Nuclear Science Advisory Committee (NSAC) and the Rare Isotope Science Assessment Committee (RISAC) of the National Research Council (NRC)

- **JLab will not present a bid to host FRIB**
  - **JLab expects to support R&D, construction and commissioning**

PUP at SNS

- The SNS Power Upgrade Project (PUP) doubles the available beam power by increasing the beam energy from 1GeV to 1.3 GeV, and increasing the beam current by 60%
- PUP requires an additional nine cryomodules, each with four high-beta cavities
- The cryomodules are expected to be built by a consortium of ORNL (SNS), JLab, and an industrial partner
  - Industry will build the cavities
  - JLab will chemically etch and clean the cavities
  - JLab may also assemble and test the cavities
  - SNS will oversee building the cryomodules
- We are currently funded by SNS to process spare cavities with excellent results (talk by Bob Rimmer)

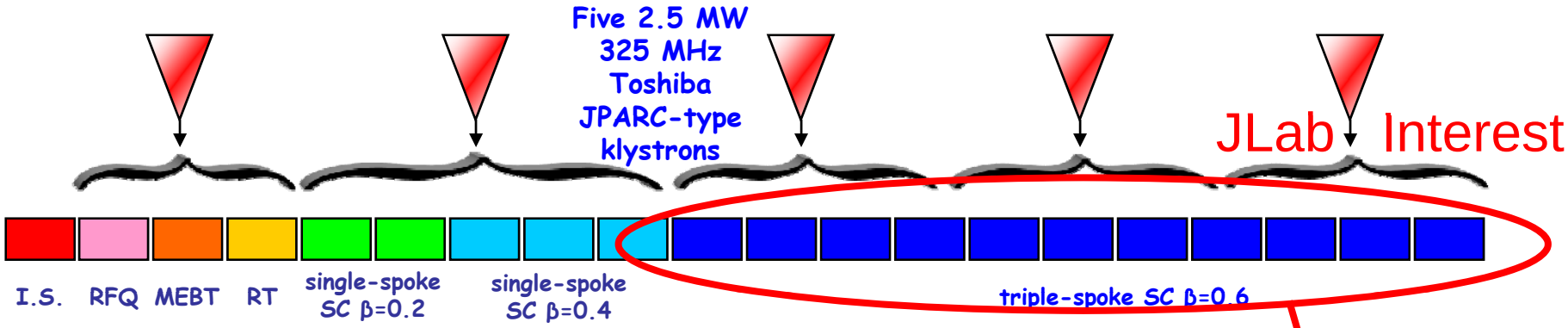
Project X at Fermilab

- The basic scheme is an 8 GeV linac operating with ILC-like parameters (9mA x 1mS x 5Hz)
  - 0.6 GeV Front End linac
  - 0.6 – 8 GeV ILC style linac
- Stripping and accumulation in the Recycler
- Beam distributed
  - to the Main Injector for acceleration to (up to) 120 GeV
  - to an 8 GeV program
- Components
  - 0.6 GeV Front End linac + 0.6 – 8 GeV ILC style linac
  - 8 GeV transfer line and H- Injection
  - Recycler as a proton accumulator and stripping ring
  - Extraction system form the Recycler
  - Main Injector
  - 120 GeV Targeting system

Project X Linacs

- 0.6 GeV Front End linac
  - We expect to be responsible for the SRF cavities, and would like a vertical slice (cryogenics, controls, RF control modules, diagnostics and beam dynamics)
    - Some of this scope may have overlap with FRIB
- 0.6 – 8 GeV ILC style linac
  - We expect to have a smaller scope of work in the high energy linac as Fermilab has made a considerable investment in SRF facilities for the ILC 9-cell cavities used for the Project X high energy linac
    - However, I believe that Fermilab will still need help from JLab to process, assemble and test cavities

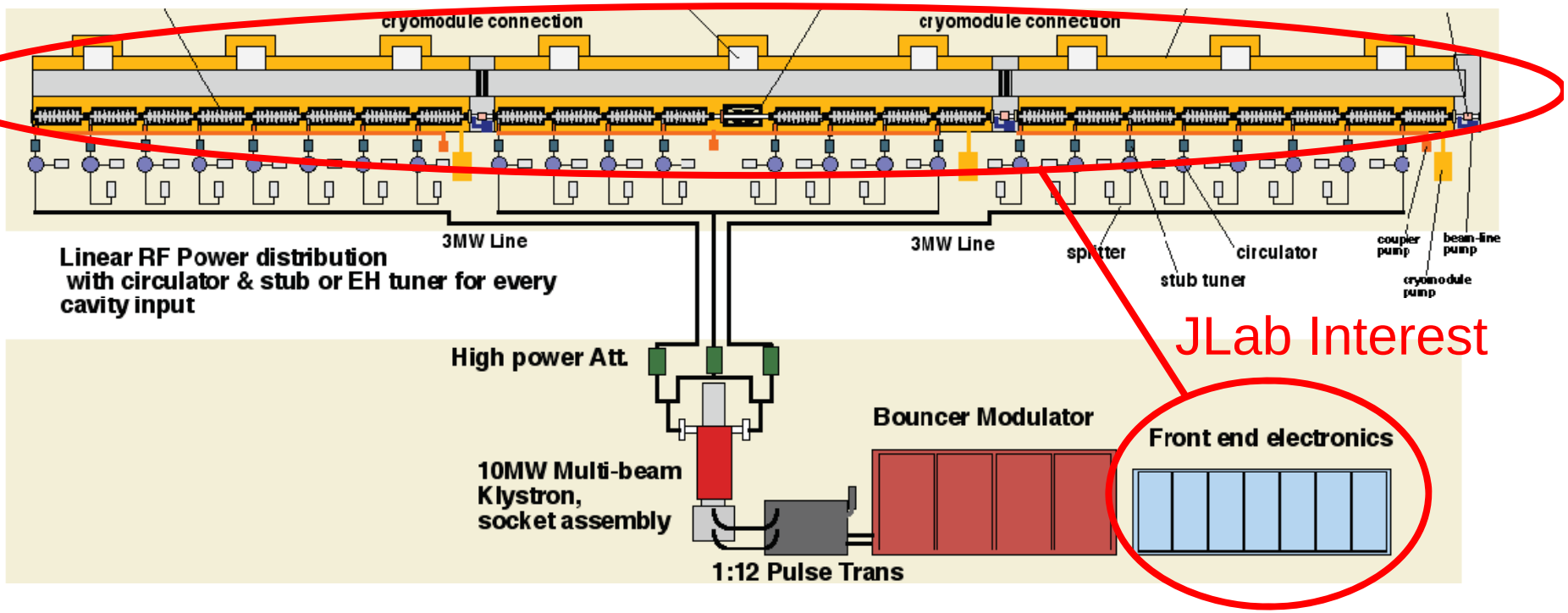
Project X Low-Energy Linac Layout Cartoon



	Ion Source	RFQ	MEBT	Room Temp	SSR1	SSR2	TSR
Eout	50 keV	2.5 MeV	2.5 MeV	10 MeV	30 MeV	120 MeV	~600 MeV
Zout	0.7 m	3.7 m	5.7 m	15.8 m	31 m	61 m	188m
Cavities			2 buncher cavities and fast beam chopper	16 copper CH-spoke cavities	18 single-spoke SC β=0.2 cavities	33 single-spoke SC β=0.4 cavities	66 triple-spoke SC β=0.6 cavities
Gradient					10 MV/m	10 MV/m	10 MV/m
Focusing			3 SC solenoids	16 SC solenoids	18 SC solenoids	18 SC solenoids	66 SC quads
Cryomodules					2	3	11

ILC RF Unit for Project X

- Some 650 units of this type will be required for the ILC and about 15 for Project -X



ILC RF Unit: 24-26 Cavities, 3 CM, klystron, Modulator, LLRF

APS 2020 Ring Upgrade

- APS 2020 program aims to improve the physics potential of the APS by targeted upgrades to the User beamlines and, to a lesser extent, the electron beam properties
- A major addition to the ring would be superconducting crab cavities to create shorter photon pulses
  - We expect JLab to continue to develop the crab cavities
    - Early R&D studies were funded in FY07
      - See results in talk by Bob Rimmer
    - Additional follow-on funds are expected in FY08
  - We expect JLab to be responsible for design and construction of the final crab cavities
  - We are negotiating to lead the design and construction of the cryomodules to house them
- Crab cavities will be required by ELIC
- Crab cavities are also required for the LHC Upgrade
  - We have tried to obtain LARP funding, so far unsuccessfully

First JLab SBIR Award from NP

- Niowave and JLab have been awarded a Phase I SBIR to develop a β=1 multi-spoke superconducting cavity
  - Our thanks to Manouchehr Farkhondeh
- Another funding source for R&D we want done

Education

FY08 Accelerator Education Activities at JLab

- Staff with University Affiliation 11
- Staff who taught at USPAS 2
- Staff who mentor graduate students 9
- Staff who taught abroad 1
- Graduate students *Present* Graduated '*01- '08*
  - PhD 21+4* 8
  - Masters 1+3* 3
- In addition,
  - 1 ODU undergraduate thesis was completed in 2008
  - High school students are mentored in special topics during the school year

*Staff Members

Education - Accelerator Physics at ODU

- The Accelerator Division continues to promote Accelerator Physics at ODU
  - Teaching one graduate level course in Low Temperature Physics (Jean Delayen) and one Introduction to Accelerator Physics to senior undergraduate/graduates (Geoff Krafft)
  - Serve on Graduate Program Committee and Condensed Matter Search Committee (Jean Delayen)
  - Serve on Graduate Recruitment and Admissions Committee (Geoff Krafft)

Education Activities, continued

- We are in advanced discussions with Old Dominion University (ODU) to create an Accelerator Science Center
  - Hope to complete negotiations before September
  - The Director of the Center would be a joint appointment between JLab and ODU
  - JLab/ODU has already received a grant from NSF (REU) for undergraduate research opportunities
    - First students already on site
- Initiated discussions with Elizabeth City State College (an HBCU) for undergraduate thesis work
  - We want to grow this program in conjunction with Hampton University (also an HBCU)

Idaho Accelerator Center

- I am pleased to announce that we have established the first ever joint appointment in accelerator physics
  - Half supported by JLab Accelerator Division
  - Half supported by Idaho State University
  - Based at the Idaho Accelerator Center
- Four candidates are being interviewed
- Initial priority is the development of a 10 MeV positron source

Summary

- The Accelerator Division is busy!
  - Balancing many exciting priorities
    - 12 GeV Upgrade
    - 6 GeV operations and hardening
    - Long-term future and R&D portfolio
    - Collaborations
    - Education
  - Staff is experienced, competent, and highly motivated
- Bright future ahead with 12 GeV and beyond (ELIC, other)!
  - We anticipate participation in ILC, FRIB, SNS Upgrade, Project X, and APS